

UNITED STATES PATENT APPLICATION

FOR

**GARMENT HAVING WIRELESS  
LOOPSET INTEGRATED THEREIN FOR PERSON WITH  
HEARING DEVICE**

INVENTOR

**Juha Kaario**

**NOKIA**

Prepared By:  
Antonelli, Terry, Stout & Kraus, LLP  
Suite 1800  
1300 North Seventeenth Street  
Arlington VA 22209  
Tel: 703/312-6600  
Fax: 703/312-6666

# **GARMENT HAVING WIRELESS LOOPSET INTEGRATED THEREIN FOR PERSON WITH HEARING DEVICE**

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## **BACKGROUND OF THE INVENTION**

### **Technical Field**

10 The present invention relates to hearing devices (e.g., hearing aids, headsets and hands-free arrangements) and especially-made garments, and more particularly, relates to garments having wireless loopsets integrated therein for enabling persons with hearing devices to conveniently use portable electronic devices more efficiently with reduced radio interference

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### **Related Art**

20 Clothes have always been to some extent a form of art and design, combining both color and functionality. Color is typically given to fabric, and to the resulting clothes, by dyeing the textile fibers. Functionality of clothes is often limited to the design and the inclusion of various materials, and elements, such as pockets or the like. For the most part, modern clothing typically includes pockets, belt loops, buttons and buttonholes, snaps, etc., and other design elements that increase its functionality.

25 Generally, the average person will wear a plurality of clothing articles or garments on a daily basis to which will be attached or placed in a pocket of the clothing, portable electronic devices, such as mobile phones, pagers, personal digital assistants (PDA), tape cassette players, compact-disc (CD) players, MD players, DAT players, televisions, radios, clock/alarms, or some other similar mobile devices. The problem is that it is often difficult and unwieldy for people to

carry various electronic devices such as mobile phones, pagers and other devices.

Smart clothing describes combining clothing with portable electronic devices. Specifically, portable electronic devices and computer technology have been incorporated into garments, such as jackets, vests, shirts or pants, so as to allow a user to better communication with others and to sense surroundings while minimizing the size of any additional portable electronic devices that the user typically carries. For example, U.S. Patent No. 5,912,653 issued to Fitch, discloses the use of a programmable video display as incorporated into a garment such as a jacket for purposes of individual expression. U.S. Patent No. 5,825,327 issued to Krasner, discloses the use of a GPS receiver and GPS antennas as incorporated into a garment such as a shirt or a pant for purposes of tracking the current location of the garment.

For most parts, smart clothing has been able to offer many users the added functionality of portable electronic devices. However, for people who have hearing problems and there are more 30 million hearing impaired persons in the United States alone, smart clothing has not made any in-road. Standard hearing aids may allow hearing impaired persons to listen better and communicate with others. A typical hearing aid contains an earpiece microphone, a speaker and associated processor electronics arranged to convert acoustic waves into electrical representations for amplification and subsequent conversion back into acoustic waves by the earpiece speaker to aid the hearing impaired persons. Most hearing aids feature an electro-magnetic pickup coil, known as a "tele-coil" or "T-coil" used to pick-up electromagnetic waves via magnetic induction, typically from a speaker having a magnetic core, or magnetic induction transmitted by an induction loop, typically installed around the walls in theaters,

classrooms, churches and the like. However, even if hearing aids are used by hearing impaired persons, many portable electronic devices, particularly mobile phones of cellular networks such as GSM systems, IS54 systems and PDC systems, still remain barely accessible due to radio interference and magnetic noise coupling between mobile phones and hearing aids having magnetic pickup coils.

Recent attempts to assist hearing impaired persons using mobile phones include a new product such as Nokia Wireless Loopset (manufactured by the Assignee), which is an electronic accessory utilizing induction loop built in 10 standard hearing aids to minimize radio interference. In addition to the hearing aid, the Wireless Loopset must be worn around the neck of a hearing impaired person like a necklace or around the body like a belt. Separate wires must be required to form an induction loop and to establish connection with a mobile phone, via an activator unit. However, the Wireless Loopset can be cumbersome 15 for everyday usage. Moreover, there are plenty of situations where hearing impaired persons do not desire to wear an electronic accessory such as the Wireless Loopset as a visible part of clothing.

Therefore, a need exists for smart clothing which incorporates the 20 essence of Nokia Wireless Loopset into a garment for allowing hearing impaired persons to conveniently use portable electronic devices such as mobile phones and similar electronic devices. More specifically, there is a need for garments having Wireless Loopsets integrated therein for enabling persons with hearing devices such as hearing aids, headsets and hands-free arrangements to 25 conveniently and comfortably use portable electronic devices such as mobile phones more efficiently with reduced radio interference.

## SUMMARY OF THE INVENTION

Accordingly, one aspect of the present invention is directed to an article of functional clothing having a wireless loopset incorporated therein for enabling persons with hearing devices to conveniently use at least one portable electronic device such as a mobile phone efficiently with reduced radio interference. One or more electrically conductive fibers are integrated or sewed into a garment such as a jacket, a vest, a shirt or a pant in a predetermined pattern to form an induction loop. An activator unit is then arranged at a predetermined location on the induction loop to establish electrical connection and thus activate the induction loop, and to provide an interface to at least one portable electronic device.

In an embodiment of the present invention, the electrically conductive fibers may contain a metallic material, a semi-metallic material, a semi-insulative material, a semi-conductive material, a transparent conductive material, pieces of metal showered to the fiber or any other fiber material that provides sufficient current to create an electromagnetic field. More specifically, each conductive fiber may consist of a central metallic core composed of an electrically conductive material, and an insulative overcoat composed of an insulative material. The electrically conductive material may contain one of a metallic material, a semi-metallic material, a semi-insulative material, a semi-conductive material, a transparent conductive material and any other fiber material that provides sufficient current to induce induction coupling between the garment and a hearing device.

In another embodiment of the present invention, the activator unit may contain a power source; a microphone; required processor electronics, and one or more interfaces which provide appropriate connection to close the induction

The following text is not part of the patent specification and is included only to illustrate the page count.

loop and to the portable electronic device, via either a transmission wire/fiber or wireless transmission. Such an activator unit may also include a fastening device, such as a metallic button, a pin, a snap, a hook, and a zipper with conductive teeth for data/power connection, arranged to close the induction loop.

5           In accordance with another aspect of the invention, there is provided a process of fabricating smart clothing. Electronically conductive fibers are integrated into a garment in a certain pattern to form an induction loop. An activator unit is formed at a certain location on the induction loop to establish electrical connection and activate the induction loop, and to provide an interface 10 to at least one portable electronic device.

The present invention is more specifically described in the following paragraphs by reference to the drawings attached only by way of example.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

15           A more complete appreciation of the present invention, and many of the attendant advantages thereof, will become readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or similar components, wherein:

20           FIG. 1 illustrates an example hearing aid for hearing impaired persons;

FIG. 2 illustrates an example Nokia Wireless Loopset for use in conjunction with an example hearing aid shown in FIG. 1;

FIG. 3 illustrates an example garment having an example wireless loopset integrated therein according to an embodiment of the present invention;

25           FIG. 4 illustrates a cross-sectional diagram of an example inductive loop fiber according to an embodiment of the present invention;

FIG. 5 illustrates an example activator unit according to an embodiment of the present invention;

FIGs. 6A-6B illustrate an example connection between inductive loop fibers and an activator unit according to an embodiment of the present invention;

5 FIG. 7 illustrates another example connection between inductive loop fibers and an activator unit according to a more particular embodiment of the present invention;

10 FIGs. 8A-8B illustrate example implementations of establishing connections between inductive loop fibers using a zipper according to a more particular embodiment of the present invention; and

15 FIG. 9 illustrates an example connection between a garment and a mobile phone according to a more particular embodiment of the present invention.

#### **DETAIL DESCRIPTION OF EMBODIMENTS OF THE INVENTION**

15 The present invention discloses smart clothing and more specifically, a garment such as a jacket, a vest, a shirt or a pant having a wireless loopset integrated therein, via electrically conductive fibers for radiating an electromagnetic field for inductive coupling or capable of a wired or wireless interface. Clothing fabricated with the wireless loopset allows persons with 20 hearing devices such as hearing aids, headsets and hands-free arrangements to achieve greater functionality, including allowing the user to better listen and communicate with others, via mobile devices, with reduced to minimal or no radio interference. Such a garment is applicable for use with various types of portable electronic devices, mobile devices, hearing devices, and cellular and radio 25 networks, including wireless local area networks, Bluetooth networks and Wideband networks. However, for the sake of simplicity, discussions will

20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

concentrate mainly on the integration of hearing aids and mobile devices into garments known as smart clothing.

Attention now is directed to the drawings and particularly to FIG. 1, an example hearing aid for hearing impaired persons to use as an earpiece is illustrated. As shown in FIG. 1, the example hearing aid 10 comprises an earpiece microphone 12, a speaker 14, associated processor electronics 16, an inductive coil 18 arranged to conventionally convert acoustic waves into electrical representations for amplification and subsequent conversion back into acoustic waves by the earpiece speaker 14 to better aid hearing impaired persons. With the more advanced functionality, the hearing aid 10 is arranged to inductively couple to an example Nokia Wireless Loopset 20 shown in FIG. 2 by the inductive coil 18 hereinbelow.

FIG. 2 illustrates the example Nokia Wireless Loopset 20 for use in conjunction with the example hearing aid 10 shown in FIG. 1. The Nokia Wireless Loopset 20 comprises an inductive wire 22 having a connector 22a at a distal end, an activator unit 24 having a receptacle 24a which receives the connector 22a of the inductive wire 22 to form an induction loop, a wire 26 extending from the activator unit 24 and having a connector 26a at a distal end which connects to a portable electronic device such as a mobile phone 30.

A publication EP 0 789 474 A2 discloses a hands-free arrangement for mobile communication device which has similar function as the combination of Nokia Wireless Loopset 20 and Hearing aid 10 as described with reference to FIG. 2. In the publication, an earphone is operating to receive and couple inductively to the induction loop, which is connected to a mobile phone. Therefore, the hands-free arrangement enables user to use the mobile phone

hands free. The hearing aid 10 is able to operate similarly when comprising the inductive loop, having of course the function of ordinary hearing aid.

The Nokia Wireless Loopset 20 represents an electronic accessory utilizing an induction loop built in a standard hearing aid shown in FIG. 1 so as to 5 reduce radio interference. However, such a Wireless Loopset 20 must always be worn around the neck of a user like a necklace or around the body like a belt.

The user must remember to carry the Wireless Loopset 20 for everyday usage.

In addition, wires 22 and 26 must be required to form an induction loop and to establish connection with a mobile phone 30, via an activator unit 24. As a 10 result, the Wireless Loopset 20 can be cumbersome for everyday usage.

Further, there are situations where hearing impaired persons do not desire to wear an electronic accessory such as the Wireless Loopset 20 as a visible part of 15 their clothing.

Turning now to FIG. 3, an example garment 200 having an example wireless loopset integrated therein according to an embodiment of the present invention is illustrated. Such a garment 200 is known as "smart clothing" because a wireless loopset is incorporated to allow persons with hearing aids to achieve greater functionality, such as allowing the user to better listen and communicate with others, via mobile devices, with reduced to minimal or no radio 20 interference. As shown in FIG. 3, the garment 200 may be a jacket, a vest or a shirt that is fabricated using electrically conductive fibers 220 to form an induction loop around, for example, the collar of the garment 200 for radiating an electromagnetic field for inductive coupling or capable of a wired or wireless interface. The garment 200 also comprises an activator unit 240 arranged to 25 close and thus activate the induction loop as well as providing an interface to the

2000 1999 1998 1997 1996 1995 1994 1993 1992 1991 1990 1989 1988 1987 1986 1985 1984 1983 1982 1981 1980 1979 1978 1977 1976 1975 1974 1973 1972 1971 1970 1969 1968 1967 1966 1965 1964 1963 1962 1961 1960 1959 1958 1957 1956 1955 1954 1953 1952 1951 1950 1949 1948 1947 1946 1945 1944 1943 1942 1941 1940 1939 1938 1937 1936 1935 1934 1933 1932 1931 1930 1929 1928 1927 1926 1925 1924 1923 1922 1921 1920 1919 1918 1917 1916 1915 1914 1913 1912 1911 1910 1909 1908 1907 1906 1905 1904 1903 1902 1901 1900 1999 1998 1997 1996 1995 1994 1993 1992 1991 1990 1989 1988 1987 1986 1985 1984 1983 1982 1981 1980 1979 1978 1977 1976 1975 1974 1973 1972 1971 1970 1969 1968 1967 1966 1965 1964 1963 1962 1961 1960 1959 1958 1957 1956 1955 1954 1953 1952 1951 1950 1949 1948 1947 1946 1945 1944 1943 1942 1941 1940 1939 1938 1937 1936 1935 1934 1933 1932 1931 1930 1929 1928 1927 1926 1925 1924 1923 1922 1921 1920 1919 1918 1917 1916 1915 1914 1913 1912 1911 1910 1909 1908 1907 1906 1905 1904 1903 1902 1901 1900

mobile phone 30. Such an interface may be wired, via a fiber or a wire 260, or wireless in compliance with Bluetooth.

One or more conductive fibers 220 are sewed, either by hand or sewing machine, into the garment 200 to form a complete induction loop. Conductive fibers 220 may be metallic fibers having insulative coating or non-metallic fibers such as carbon, plastic or optical fibers. Optical fibers may be advantageous since they are prone to corrosion and wear and can withstand repeated washing and detergents commonly found in washing machines and driers. If optical fibers are utilized to form an induction loop, such optical fibers are used to convey data information between the activator unit 240 and the mobile phone 30. In a more particular embodiment, however, the conductive fibers 220 are laminated by other textile fibers for added protection from normal wear and tear. In addition, the conductive fibers 220 exhibit a diameter of approximately 0.5 to 1 mm, and the garment 200 exhibit a diameter of approximately 2.2 mm. Also, advantageously for inexpensive manufacturing process, one or more conductive fibers 200 may also be composed by showering pieces of metal among non-conductive fibers.

In a more particular embodiment of the present invention, the activator unit 240 is a piece of jewelry, which is hooked to the garment 200 to enable the user to use the wireless loopset. Alternatively, the activator unit 240 is a fastening device arranged to close the induction loop. Examples of such a fastening device include, but not limited to, a metallic button with set order (2 connections for voice out and 2 connections for voice in), a pin, a snap, a hook, a zipper with conductive teeth for data/power connection or even a Velcro<sup>TM</sup>. In addition, standard plugs and other "traditional" computer/electronic industry data connectors may also be used to connect the conductive fibers 220 and thereby

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close the induction loop (for example, when a jacket is closed the induction loop is closed OR when the activator unit is inserted into the garment, the induction loop is also closed at the same time). A button or a zipper is advantageous if an order of connectivity is desired since both are connected in a known fashion.

5 FIG. 4 illustrates a cross-sectional diagram of an example conductive fiber 220 according to an embodiment of the present invention. Referring now to FIG. 4, a single electrically conductive fiber 220 includes a central metallic core 222 and an insulative overcoating layer 224. Central metallic core 222 composes of 10 an electrically conductive material, which includes a metallic material, a semi-metallic material, a semi-insulative material, a semi-conductive material, a transparent conductive material and any other fiber material that provides sufficient current to induce induction coupling between the garment 200 and a hearing device such as a hearing aid 10, and wired connection between the garment 200 and a portable electronic device such as a mobile phone 30.

15 Insulative overcoating 224 composes of an insulative material, such as KELVAR, as commonly used in the fiber optic industry, a plastic material, such as any organic polymer based material, for example PMMA or polyimide, or some other similar insulative material. Insulative overcoating 224 serves to 20 insulate central metallic core 222 from defining electrical connections where they are not desired. For example, the insulative overcoating 224 prevents electrical cross-talk, more specifically, signal crossings from individual conductive fibers 220. Alternatively, conductive fibers 220 are formed of a solid metallic fiber, or a fiber having a non-metallic core and a metallic overcoating.

25 Electrically conductive fibers 220 includes, a metallic material, a semi-metallic material, a semi-insulative material, a semi-conductive material, a transparent conductive material or any other fiber material that provides sufficient

current to create an electromagnetic field. More particularly, metallic materials may include steel, iron, nickel, cobalt, copper, gold, chromium, molybdenum, tungsten, tin, zinc, manganese, thallium, aluminum, magnesium, and the like and mixtures thereof.

5 Semi-insulative materials includes gallium nitride (GaN), aluminum nitride (AlN), and the like. Semi-metallic and semi-conductive materials may include binary materials such as gallium arsenide (GaAs), aluminum phosphide (AlP), aluminum arsenide (AlAs), gallium phosphide (GaP), indium phosphide (InP), indium arsenide (InAs), gallium antimonide (GaSb), indium antimonide (InSb),  
10 zinc selenide (ZnSe), and the like. Ternary materials may include gallium arsenide phosphide (GaAsP), aluminum gallium arsenide (AlGaAs), gallium indium antimonide (GaInSb), aluminum gallium phosphide (AlGaP), gallium indium arsenide (GaInAs), indium arsenide antimonide (InAsSb), and the like.  
15 Transparent conductive materials includes transparent metals such as indium oxide (InO), tin oxide (SnO), indium-tin-oxide (ITO), or the like.

FIG. 5 illustrates an example activator unit 240 according to an embodiment of the present invention. As previously described, such an activator unit 240 is a piece of jewelry, or a fastening device, such as a metallic button, a pin, a snap, a hook, and a zipper with conductive teeth arranged to close the induction loop. As shown in FIG. 5, the activator unit 240 includes a power source 242, a microphone 246, required processor electronics 246, and one or more interfaces 248 which provide appropriate connections to close the induction loop and to the mobile phone 30, via either a transmission wire/fiber or wireless via Bluetooth.

25 FIGs. 6A-6B illustrate an example connection between inductive loop  
fibers 220 and an activator unit 240 in a garment 200 according to an

embodiment of the present invention. If the garment 200 is a jacket, a vest or a shirt, the conductive fibers 220 are sewed around the collar of the garment 200. The activator unit 240 corresponds to a metallic button as shown in FIG. 6A which is inserted into a corresponding button hole to establish connections 5 between the conductive fibers 220 so as to close the induction loop. FIG. 6B illustrates a side view of the activator unit 240 in a form of a metallic button inserted, via a button hole. The conductive fibers 220 are protected by insulation or non-conductive fibers, such as normal textile fibers 220N. A fastener 240N is utilized to secure the activator unit 240 in the button hole to close the induction 10 loop.

FIG. 7 illustrates another example connection between inductive loop fibers 220 and an activator unit 240 in a garment 200 according to another embodiment of the present invention. As shown in FIG. 7, a zipper 70 with conductive teeth for data/electric connection is utilized to serve as an interface 15 248 of the activator unit 240 so as to establish connections between the conductive fibers 220 forming an induction loop. The zipper 70 includes a plurality of teeth where some are conductive teeth 72, some are insulative teeth 74, and some may be neither insulative teeth 74 nor conductive teeth 72. Both the conductive teeth 72 and the insulative teeth 74 are connected to conductive 20 fibers 220 and non-conductive fabrics 220N of the garment 200 as described with reference to FIG. 6B. More specifically, the conductive fibers 220 which form an induction loop around the collar of the garment 200 are electrically connected to the conductive teeth 72 so as, when the zipper 70 is closed, the conductive teeth 72 close the induction loop for transferring data and information through the 25 conductive fibers 220. Alternatively, the processor electronics 246 processes the

data information or conducts the current, which flows in the conductive fibers

220. Such a zipper 70 is desirable if an order of connectivity is desired.

FIGs. 8A-8B illustrate example implementations of establishing  
connections between conductive fibers 220 using a zipper 70 according to an  
embodiment of the present invention. As shown in FIG. 8A, the conductive fibers  
220 are manufactured in conductive teeth 72 of a zipper 70 whereby each tooth  
of the zipper 70 includes a flat surface 76 where pairs of teeth 72 may be  
connected. The conductive fibers 220 meet end-to-end to form an induction loop  
around the garment 200. In addition, as shown in FIG. 8B, all teeth in the zipper  
70 are alike, possibly made out of a transparent material which allows the  
conductive fibers 220 to be connected end-to-end in a parallel fashion without  
direct contact but still maintain connectivity.

FIG. 9 illustrates an example connection between a garment 200 and a  
mobile phone 30 according to an embodiment of the present invention. The  
garment 200 contains one or more pockets, and at least one pocket 210 is  
fabricated with the required fiber/wire connector 230 for establishing a connection  
between an activator unit 240 and a mobile phone 30. The pocket 210 which has  
the required fiber/wire connector 230 is permanently sewed into the garment 200.  
However, such a pocket 210 can also be removable from the garment 200 if  
separate connectors are used to connect to the garment 200 (actually one extra  
connector).

As described from the foregoing, the garment having a wireless loopset  
integrated therein using electrically conductive fibers for radiating an  
electromagnetic field for inductive coupling, or capable of a wired or wireless  
interface advantageously allows persons with hearing devices to achieve greater

functionality, such as allowing the user to better listen and communicate with others, via mobile devices, with reduced or no radio interference.

While there have been illustrated and described what are considered to be preferred embodiments of the present invention, it will be understood by those skilled in the art that various changes and modifications may be made, and equivalents may be substituted for elements thereof without departing from the true scope of the present invention. For example, other types of fastening devices with conductive elements not described herein may be utilized to activate connections of conductive fibers in a garment and to provide information regarding the status of such connections to processor electronics (i.e., if the fastening device is fastened or unfastened). Depending on the status of the fastening device, portable electronic devices such as mobile phones, pagers, personal digital assistants (PDA), tape cassette players, compact-disc (CD) players, MD players, DAT players, televisions, radios, clock/alarms, or some other similar mobile devices, may be automatically activated or deactivated based on the position of the fastening device. The fastening device may also be part of a bus (standard bus). This way when the fastening device is fastened, individual signal lines which are part of the bus may be opened when the fastening device is unfastened, and closed when the fastening device is fastened. The garment may also include connectors that are connected to the wires that allow for attachment of various portable electronic devices and removal of portable electronic devices from the garment for cleaning purposes.

The invention may also be applied as a hands-free/headset arrangement for mobile communication device with or without the actual ordinary hearing aid, which is directed mainly for hearing impaired persons. In this case, the user has mobile phone accessories according to the invention enabling the information

conducting between the phone, the loop and the earphone device.

Further, many modifications may be made to adapt a particular situation to the teachings of the present invention without departing from the central scope of the present invention. Therefore, it is intended that the present invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out the present invention, but that the present invention includes all embodiments falling within the scope of the appended claims.